

## COTTON REGION REPORTS.

In the following table are given the means of the maximum and minimum temperatures and the average rainfall for the cotton districts during the month of September. For the purpose of comparison, the averages for these districts during the four preceding years are also given. The rainfall, as compared with the averages of four years, is largely deficient in the states of North Carolina, South Carolina, Georgia, Florida, and Alabama; the deficiencies are especially large in the districts of Montgomery, Atlanta, Savannah, and Charleston, producing in those districts a drought which was injurious to some crops but rather favorable for gathering the rapidly opening cotton. The monthly rainfall of the districts of Little Rock and Galveston was more than double the usual amount. The means of the maximum and minimum temperatures are above the average in nearly all districts:

Temperature and rainfall data for the cotton districts, September.

Districts.	Rainfall.		Temperature.									
			Maximum.					Minimum.				
	Average for September of four preceding years.	Average for September, 1886.	Departures.	Mean for Sept. of four preceding years.		Departures.	Mean for Sept. 1886.	Mean for Sept. of four preceding years.		Departures.	Mean for Sept. 1886.	Extremes for Sept., 1886.
				Inch.	°		°	Inch.	°		°	Max.
New Orleans.....	2.91	4.14	+ 1.23	87.7	86.8	- 0.9	66.3	68.8	2.5	97	43	
Savannah.....	4.22	1.92	- 2.30	86.3	88.0	+ 1.7	67.1	68.9	1.8	99	43	
Charleston.....	4.60	2.02	- 2.58	84.4	85.7	+ 1.3	64.5	65.8	1.3	96	54	
Atlanta.....	3.02	1.00	- 2.02	83.5	85.4	+ 1.9	62.7	65.2	2.5	95	48	
Wilmington.....	4.79	2.42	- 2.37	82.1	84.4	+ 2.3	61.6	64.8	3.2	97	50	
Memphis.....	2.26	3.56	+ 1.30	84.8	84.5	- 0.3	60.7	63.2	2.5	95	34	
Galveston.....	3.60	6.75	+ 3.15	87.7	88.2	+ 0.5	65.6	69.5	3.9	100	36	
Vicksburg.....	3.46	4.15	+ 0.69	87.3	88.1	+ 0.8	64.1	69.7	5.6	97	48	
Montgomery.....	2.07	0.56	- 1.51	86.1	87.5	+ 1.4	63.4	66.7	3.3	95	38	
Augusta.....	3.09	1.94	- 1.15	84.8	85.8	+ 1.0	65.2	65.8	0.6	96	53	
Little Rock.....	1.95	5.41	+ 3.46	86.1	86.7	- 0.6	59.4	64.1	4.7	100	40	
Mobile.....	1.99	1.81	- 0.18	88.4	87.5	- 0.9	65.0	65.7	0.7	99	42	

## RAINFALL IN THE TEXAS COTTON REGION.

The following, from the special annual edition of the "Galveston News," of September 1, 1886, containing a tabulated statement and remarks on the rainfall in the Texas Cotton region, from April 1st to October 31st, for the years 1882, 1883, 1884, and 1885, and from April 1st to July 31, 1886, was prepared by Mr. E. O'C. MacInerney, Collector of Customs at Galveston, Texas, from data furnished by the Signal Service:

Station.	1882.	1883.	1884.	1885.	1886.
Austin.....	13.90	13.38	9.27	10.98	6.41
Beaumont.....	1.51	8.08	14.81		
Belton.....	6.72	10.54	18.76	6.26	11.85
Bronham.....				3.69	7.99
Columbia.....			7.83	20.41	5.13
Corpus Christi.....	18.18	6.57	20.34	17.06	8.79
Cuero.....	7.22	12.03	13.29	17.86	6.30
Dallas.....	23.06	16.56	22.44	22.25	3.31
Galveston.....	36.40	20.78	38.45	45.96	9.57
Hearne.....	10.85	12.05	18.40	22.75	7.84
Hempstead.....	13.04	12.91	21.86		
Houston.....	18.75	28.94	43.81	18.48	10.66
Huntsville.....	17.86	15.04	19.66	18.86	9.22
Longview.....	2.57	1.87	12.98	32.73	9.74
Luling.....	11.14	13.45	17.20	0.15	2.03
Orange.....		1.14	7.84	8.38	0.39
Palestine.....	35.56	20.75	33.37	21.26	7.50
San Antonio.....	26.24	8.10	11.80	23.57	9.12
Sour Lake.....	29.72	21.09	28.95	22.63	12.17
Tyler.....	22.46	16.70	32.27	7.97	4.92
Waco.....	18.40	8.68	17.82	25.21	4.20
Weatherford.....	14.08		41.89	19.88	2.01
Weimer.....	10.50	11.57	23.95	21.61	7.08
Annual totals.....	408.16	260.13	477.06	357.95	146.26

The tables are instructive to the extent of showing that in the year 1883, when the rainfall was below the average, the cotton crop for that season was also below the average.

In 1884, while the total amount of rainfall was above the average, its distribution was so uneven as to cause a shortage as marked as if the rainfall had not been up to the average. Of the 477.06 inches reported for the seven months from April 1st to October 31, 1884, 374.25 inches fell during the three months of April, May, and September, leaving but 102.81 inches for the months of June, July, August, and October. Owing to the great evaporating

power of the sun in the months of June, July, and August, they are the months in which the rainfall is the most needed. Any lack of a sufficiency of rain during these three months must necessarily be followed by a proportionate impoverishment of crops, particularly of the cotton crop. Should this assumption be correct, it would be consistent to assume that the cotton crop of Texas for the current year will fall below the expectations of the early spring, but perhaps not so much so as might be expected in comparison with the small rainfall from April 1st to July 31st, viz., April 53.93, May 4.85, June 48.87, and July 38.61 inches, on account of the fact that in June and July it was so much greater than in the two months of April and May. \* \* \*

The Chief Signal Officer recognizes that the reports are not all that they should be, but they are the best that the means at hand can secure. A larger appropriation for this branch of the service has been requested, and those interested in it should see that this feature of the Signal Service work is properly supported.

## NAVIGATION.

## STAGE OF WATER IN RIVERS.

The Ohio River was very low throughout the month; at Louisville, Kentucky, navigation was partially suspended. In the following table are shown the danger-points at the various river stations; the highest and lowest depths for September, 1886, with the dates of occurrence, and the monthly ranges:

Heights of rivers above low-water mark, September, 1886.

[Expressed in feet and tenths.]

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
<i>Red River:</i>						
Shreveport, Louisiana.....	29.9	30	1.4	12	1.0	2.4
<i>Arkansas River:</i>						
Fort Smith, Arkansas.....	22.0	15	8.7	1, 2	2.5	6.2
Little Rock, Arkansas.....	23.0	19	6.5	5	2.3	4.2
<i>Missouri River:</i>						
Yankton, Dakota.....	24.0	1, 2	17.8	30	16.6	1.2
Omaha, Nebraska.....	18.0	1 to 4	8.0	25, 30	7.0	1.0
Leavenworth, Kansas.....	20.0	1, 5	6.8	23 to 28	5.6	1.2
<i>Mississippi River:</i>						
Saint Paul, Minnesota.....	14.5	9	2.8	2	2.0	0.8
La Crosse, Wisconsin.....	24.0	24, 25	6.2	15	3.3	2.9
Dubuque, Iowa.....	16.0	29, 30	5.8	18	3.1	2.7
Davenport, Iowa.....	15.0	29, 30	3.8	15 to 18, 22, 23	2.0	1.8
<i>Ohio River:</i>						
Keokuk, Iowa.....	14.0	30	3.4	1	1.7	1.7
Saint Louis, Missouri.....	32.0	29, 30	7.4	2, 3	5.9	1.5
Cauro, Illinois.....	40.0	1	10.2	17	5.3	4.9
Memphis, Tennessee.....	34.0	1, 2	8.4	18, 19, 29, 30	5.4	3.0
Vicksburg, Mississippi.....	41.0	1, 2	8.3	23, 30	4.5	3.8
New Orleans, Louisiana.....	13.0	9	4.2	16, 17, 18, 29	2.7	1.5
<i>Cumberland River:</i>						
Nashville, Tennessee.....	40.0	20	10.0	14	2.2	7.8
<i>Tennessee River:</i>						
Chattanooga, Tennessee.....	33.0	1	3.4	27 to 30	2.0	1.4
<i>Monongahela River:</i>						
Pittsburg, Pennsylvania.....	29.0	30	6.9	1	0.8	6.1
<i>Savannah River:</i>						
Augusta, Georgia.....	32.0	16	11.0	30	5.9	5.1
<i>Mobile River:</i>						
Mobile, Alabama.....		25	18.8	5, 19	16.7	2.1
<i>Sacramento River:</i>						
Red Bluff, California.....						
Sacramento, California.....		1, 2	8.2	15 to 30	7.5	0.7
<i>Willamette River:</i>						
Portland, Oregon.....		1, 2	3.9	22	1.1	2.8
<i>Colorado River:</i>						
Yuma, Arizona.....		6	18.7	4, 29, 30	15.5	3.2

## FLOODS.

Sioux City, Iowa: heavy rain fell on the afternoon of the 6th, doing much damage. The sewers were inadequate to carry off the volume of water, in consequence of which the streets were flooded, and in some parts of the town houses damaged.

Raleigh, North Carolina: on the 9th heavy rain fell throughout eastern North Carolina, flooding streams and overflowing the lowlands. A large mill dam on Walnut Creek was broken by the pressure of the water and several flouring mills were carried away and bridges wrecked.

Santa Fé, New Mexico: during the 11th, 12th, and 13th heavy rains fell in the region between Socorro and Albuquerque, New Mexico, washing away several miles of the Atchison, Topeka, and Santa Fé Railroad bed. A bridge over the Salida River was badly damaged by the freshet. About twenty-five

adobe houses were destroyed in Socorro and a number washed away in San Marcial.

Reed City, Osceola county, Michigan: a severe thunder-storm prevailed between 4 and 9 p. m. of the 24th. The storm was accompanied by unusually heavy rain which flooded streams and damaged property in this county to the extent of \$50,000. The Grand Rapids and Indiana Railroad was badly washed out between Reed City and Crapo. Several mill dams in the Hersey River broke during the night, considerably increasing the volume of water in the stream and causing several wash-outs along the line of the Flint and Péré Marquette Railroad.

#### HIGH TIDES.

Eastport, Maine, 28th, 29th.  
New York City, 28th.  
Smithville, North Carolina, 30th.  
New River Inlet, North Carolina, 3d, 14th.  
Wash Woods, North Carolina, 29th.  
Cedar Keys, Florida, 25th.  
Galveston, Texas, 24th.  
Bainbridge Island, Washington Territory, 28th.

#### LOW TIDES

New River Inlet, North Carolina, 17th.  
Cedar Keys, Florida, 21st.

#### ATMOSPHERIC ELECTRICITY.

##### AURORAS.

Tatoosh Island, Washington, Territory: a white auroral light was seen at 9.10 p. m. of the 9th. The aurora increased in brightness and at 9.40 p. m. it had changed in color from white to a bright yellow and extended from 30° west to 40° east of the magnetic meridian, altitude 15°. Shortly after 10 p. m. numerous well defined streamers appeared. The display continued visible until dawn of the 10th.

Escanaba, Michigan: an auroral light was visible from 1 a. m. until dawn of the 10th; it was again visible at 11 p. m. in the form of several long streamers. The light was obscured by clouds at 12.30 a. m. of the 11th.

Duluth, Minnesota: an auroral light was visible at 11.20 p. m. of the 10th; at 11.30 p. m. beams were quite numerous. The light was obscured by clouds at 1.45 a. m. of the 11th.

Mackinaw City, Michigan: an auroral light was seen at 7.50 p. m. of the 20th; azimuth, 90°; altitude, 20°; color, very light pink.

Eastport, Maine: an auroral arch of about 10° altitude was visible from 7.45 to 10.10 p. m. of the 20th. A faint auroral light was seen from 7.30 p. m. of the 21st until after midnight. An indistinct auroral arch of a dull white color was visible from 11 p. m. of the 29th until 1 a. m. of the 30th.

Alpena, Michigan: a faint auroral light was seen on the northern horizon at 9 p. m. of the 20th; it disappeared at 11.38 p. m.

Fort Buford, Dakota: an arch of auroral light, was seen on the 29th at 10.15 p. m., extending 15° on each side of the north point of the horizon. The light was visible until after midnight.

Saint Vincent, Minnesota: at 10.25 p. m. of the 30th a white auroral light was seen in the north, rising to an altitude of about 20° and having an azimuth of 90°. The display was not active but remained as first observed until after midnight.

Mackinaw City, Michigan: at 10 p. m. of the 30th an auroral light could be seen through breaks in the clouds. The sky began to clear at 10.30 p. m., showing the light to be of a gray color; altitude 20°; azimuth 75°.

Auroras were also observed during the month, as follows:

8th.—Cambridge, Massachusetts.  
9th.—Vevay, Indiana.  
10th.—Windsor, Illinois; Vevay, Indiana; Bancroft, Iowa; Poplar River, Montana.  
11th.—Bethlehem, Pennsylvania.  
13th.—Fort Totten, Dakota.  
14th.—Wellsborough, Pennsylvania.

15th.—Windsor, Illinois.

17th.—Vevay, Indiana; Duluth, Minnesota.

19th.—Pekin, Illinois.

20th.—Cornish and Orono, Maine; Blue Hill Observatory, Cambridge, and Milton, Massachusetts; Escanaba and Traverse City, Michigan; Nashua, New Hampshire; Embarras, Wisconsin.

21st.—Fort Totten, Dakota; Cambridge, Massachusetts.

22d.—Pekin, Illinois.

23d.—Pekin, Illinois.

27th.—Kalamazoo, Michigan.

29th.—Gardiner and Orono, Maine; Cambridge, Massachusetts; Poplar River, Montana.

30th.—Fort Totten and Webster, Dakota; Bancroft, Iowa; Gardiner and Cornish, Maine; Berlin Mills, New Hampshire; Oswego, North Volney, and Syracuse, New York.

#### THUNDER-STORMS OF SEPTEMBER, 1886.

[By Jr. Prof. H. A. HAZEN.]

The total number of reports during September were, as follows: voluntary observers, 450; Signal Service, 181; special thunder-storm observers, 1,079; making a total of 1,710. The days of greatest frequency were, 10th, 92; 19th, 174; 18th, 108; 19th, 176; 22d, 133, and 23d, 130; and of least, 1st, 10; 4th, 22; 6th, 23; 14th, 11; 20th, 18; 25th, 17; 29th, 14; and 30th, 0. The day of greatest number was the 19th, and, contrary to the usual law, most of these storms occurred not far from 7 a. m. The conditions of pressure, temperature, and wind-direction are exhibited on chart number viii. The figures printed very near the centre of each state indicate the number of storms reported in each case. As the number of stations in Ohio is much greater than in other states, the number of storms has been divided by ten in that state.

#### CHART OF ELECTROMETER READINGS.

[Prepared under the direction of Prof. T. C. MENDENHALL, Assistant.]

Observations have been made during the month of September at the six stations supplied with the necessary apparatus.

At Washington City, the highest indication was given on the afternoon of September 3d, during prevalence of haze. The lowest indication was given on the afternoon of the 26th, during cloudy, windy weather when the barometer was falling rapidly; this is the only date of negative electricity during the month, although there are several dates of very low positive. Rain occurred on the 8th at 11 a. m., during early morning of the 9th, and on the 15th during the 9 a. m. and 1 p. m. observations. All of these dates show at the time of rain much lower values than the average.

On September 7th, during the afternoon, a set of observations was made at the top of the Washington Monument. The wind was light, from the east, the sky nearly covered with cumuli clouds. The values obtained were very steady in character and rather below the average. It was noticed, however, that on grounding the needle, a spark could be obtained, although the potential indicated was less than 300 volts. On several other occasions when sparks have been given in this way the potential indications were very much greater. On several clear days the lowest values of the potential, at which sparks could be obtained, exceeded 700 volts. About 3 p. m. on this date, September 6th, the cumulus clouds disappeared and the sky remained generally clear, excepting a few cirro-stratus clouds and a light haze. This change did not affect the character or value of the indications to any marked extent.

The first diagram of chart vi represents a set of observations made simultaneously at the top of the Washington Monument and at the Instrument Room of the Signal Office on September 21, 1886. The difference in elevation of the two places is about four hundred and fifty feet. It was a bright day, the wind from the northwest, and a trifle hazy. The values obtained at the Monument were much less than might have been expected from the character of the day. On September 26th observations were again made at the Monument, and, as before, the potential values were quite low; the values at the Signal